Chapter

The Lidia Breed: Management and Medicine

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Abstract

The Lidia breed, originally from Spain, constitutes an important livestock sector in Spain and Portugal. These animals are also bred in southern France and in several countries of South America (Mexico, Colombia, Peru, Ecuador, and Venezuela). The clinical management of this breed is different from other cattle breeds; therefore, it is essential to analyze the characteristics of the farm organization, the selection scheme, the reproduction, feeding, and healthcare management. The sector is currently evolving with high progress in feeding, selection, and assisted reproduction. Not surprisingly, there are several problems that the farmers and veterinarians must overcome such as health problems, the falling syndrome, and the danger of extinction of certain genetic lines.

Keywords: Lidia cattle, management, clinic, fighting bull

1. Introduction

Lidia's cattle breeding has been, and continues to be, one of the most genuine animal production sectors, due to the particular ethological characteristics of this breed and the peculiarities of the production system and the product obtained, in this case suitable animals for the show [1].

Spain is the first Lidia cattle breeding country and has the most varied and important genetic heritage of this breed [2] that is also present in Portugal, southern France, and much of South America such as Mexico, Colombia, Venezuela, Peru, and Ecuador [3].

Lidia cattle sector represents in Spain a socioeconomic activity of considerable importance, with a total turnover of approximately 1.5 billion euros per year, which does not only affect entrepreneurs, ranchers, and bullfighters, but also more than 200,000 jobs that depend directly or indirectly on the bullfighting activities [4], which constitute the second mass spectacle of Spain and Portugal [5]. Lidia cattle, the second pure breed in the bovine census in Spain [6], are considered the greatest exponent of an extensive breeding system, due to their ethological characteristics, the need for wide spaces, and the difficulty in handling that it presents [7]. In turn, it is a breed of great rusticity, able to adapt and take advantage of all types of terrain, including those of extreme weather conditions [8]. Many farms are located in territories of high landscape value such as natural parks, playing an important role in maintaining biodiversity and contributing to the conservation of the ecosystem [9].

The characteristics of a Lidia standard farm are an average size of 253 mother cows and a total number of heads of 748 animals, including animals of other

Sires	3
Cows	100
Calf male <1 year	40
Males 1–2 years	38
Males 2–3 years	36
Males 3–4 years	35
Bulls 4–6 years	34
Calf female <1 year	40
Heifers 1–2 years	36
Heifers 2–3 years	20
Halters	12

Table 1.
Internal distribution of a standard Lidia farm considering the different types of animals classified by sex and age [11].

breeds or those belonging to other species, necessaries for livestock's handling, with an annual replacement rate of 12% [10]. However, after the economic crisis of 2008, most livestock farms have decreased the number of heads. Nevertheless, the livestock internal distribution remains stable. For a Lidia cattle farm of 100 mother cows, the ideal average internal scheme, considering the different types of animals classified by sex and age, could be the one presented in **Table 1** [11].

The standard farm has a number of hectares ranging from 586 to 721, of which 92% of the land is used as pastures [12].

2. Feed management

Today, the farming system of the Lidia breed continues to be, mainly, an extensive management system that has gradually adapted to new grazing techniques and food supplementation in times of natural grass decline, such as winter and summer, in dry climates [13]. The extension of the farms is still remarkable, but of much less spacious than that of several decades ago and in terms of quality, the brave cattle have been relegated to less productive and more stepped mountain farms in favor of agriculture or other more profitable species, such as the Iberian pig in Spain and Portugal [7]. In Mexico, most farms are located in the central part of the country, with a dry climate similar to Spain, carrying out similar feeding management. On the other hand, Lidia cattle in Colombia, Venezuela, Ecuador, and Peru are in territories with a tropical climate, whose diet is based on natural grass with a concentrated supplementation during the last stage of preparing the males for the show [14].

2.1 Cow feeding

The Lidia cow is a very rustic animal, of few requirements, since its small size also dictated its nutritional needs. Even so, adequate feeding is essential to obtain a good fertility rate, avoiding abortions and perinatal mortality, and, after a good lactation, wean the calf in an optimal state [7, 15]. Currently, the use of natural resources is maximized, preferably by grazing and the supplementation of hay or silage, and if necessary, concentrated food is used at a rate of 2–4 kg/day, depending on the richness of the grass and forage [16, 17].

2.2 Feeding of young animals

During the first 3–4 months, calves are fed exclusively with cow's milk and develop optimal growth, as long as it comes from a well-fed cow that produces milk of adequate quality and quantity.

After weaning, and when the animals are between 9 and 10 months old, they are usually supplemented in times of shortage of grass with rations whose fundamental components are fibrous products (beet and citrus pulps, dehydrated or henified alfalfa, and cereal straw), industrial by-products (gluten-feed, wheat bran, soy cake, and beet molasses), and common products in the composition of concentrates of other types of farm animals (corn, barley, wheat, and sunflower meal).

Galvanized iron feeders are frequently used, 5 m long by 40 cm wide approximately, which allow to guarantee half a meter of free space per animal, avoiding hierarchy problems, present in any group of this breed, which could result in some type of undernourishment particularly important in this stage of development. Likewise, several water points distributed along the fenced space must be installed, arranged around the feeder area, to favor the movement of animals across different areas and to avoid their concentration in one point.

When the animals are around 23 months of age, they are slowly provided, during 4 weeks of adaptation, an increasing proportion of the ration designed for adult animals of 3 and 4 years, in order to adapt them to the finishing feeding diet composition.

Livestock facilities used for these animals have similar characteristics to the ones described for young animals, although in case of using individual feeders, the number of feeders is usually 10% greater than the number of animals to be fed [18]. Also, the different water points are often installed at a greater separation distance from the feeders (at least 500 m), to facilitate a better distribution throughout the land surface. As in previous phases, a supplementation is necessary, which as an example could be based on the addition of 0.5 kg of alfalfa hay to the total supplementation established in the previous phase, thus leaving 2.5 kg of alfalfa hay added to 0.5 kg of concentrate per animal per day [15].

2.3 Bull feeding (4–5 years)

The feeding systems described during the 1980s based on a final bait are still in force today. Although each farmer has its own feeding methodology, depending on the availability of grass and other types of food on the farm, the possibility of growing the forage or concentrate on the farm itself or the use of agricultural by-products such as citrus pulp or some derived from the olive oil industry.

This final bait is carried out in fenced areas of small size, frequently without grass, with a daily supply of rations of high energy concentration and high digestibility [19]. This last feeding stage is called "pre-lidia bait" or "finishing," and it can vary between 5 and 12 months and usually begins during the winter [20], adapting the amount of ration supplied to the bulls at the date on which they have to fight.

The average fenced area used for these bulls is usually around 60 hectares per farm, and the average number of animals per enclosure is 20 (which is equivalent to a density of 3 hectares per bull), although each farm distributes its animals in a way different. The average daily gain (GMD) is approximately 450 g/day (**Figure 1**), which means that in this period, the bulls gain about 150 kg of weight, 30% of their final body weight, considering a standard bull of 500 kg of weight at 4 years of age [7].

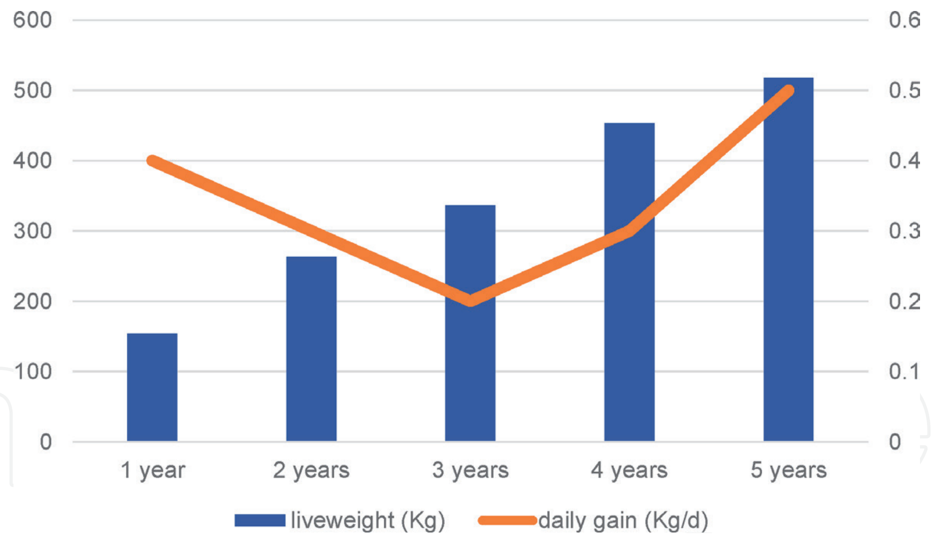

Figure 1.
Lidia bull growth estimation [9].

The use of long feeders is common, especially in southern Spain, compared to the classic individual and small feeder used in farms located on the center of Spain (**Figure 2**). The distribution of food is done during the morning and the afternoon in most of the farms [21].

There is a critical point in the strategy of feeding management, due to the overfeeding carried out during the last year, prior to the fight, which causes an overload of weight in the bone structure, added to the state of obesity that causes a lack of strength and mobility of the animal that limits its behavior in the arena and, therefore, the show itself.

The problem lies in the overfeeding to which it is subjected in the final phase of its growth during variable periods of time (from 8 to 12 months) that generates a series of pathologies and inconveniences that negatively influence its productive aptitude: the behavior in the ring.

Several studies have been carried out on the effect of intensive bait on rumen physiology of Lidia cattle [16, 20, 22–31], and all of them point to ruminal acidosis, a primary pathology that predisposes the appearance of secondary lesions such as liver abscesses, gastrointestinal ulcers, ruminal parakeratosis, laminitis, anthill, and so on. Later we will address this pathology more widely.

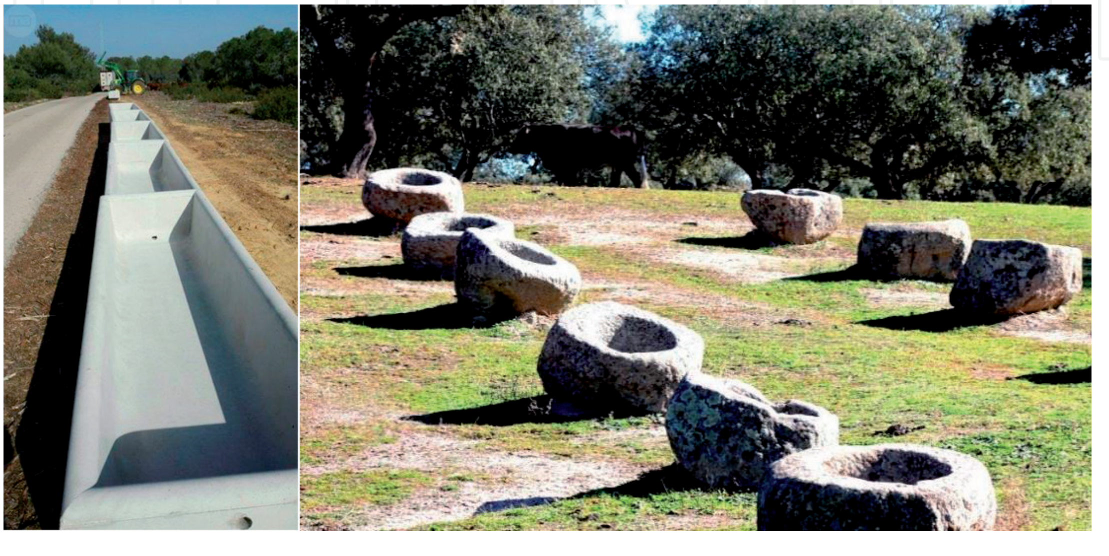

Figure 2.
Long feeder and single feeders.

3. Reproductive management

Lidia females reach puberty at approximately 12 months of age but must reach the two-third of adult body weight before becoming pregnant [7] at approximately 2 years of age, and the productive lifespan time lasts for 8–10 years with a calving-gestation interval of 2–4 months [32].

Lidia bulls begin to show sexual activity from 6 months of age reaching puberty at 10–12 months, having been necessary to separate them from females before 1-year olds [7]. At 2 or 3 years, the selected sires are tested with a small group of females, but they are not profusely used until their female offspring are tested, and the quality of their genetic is proved, once this happens, they could be 15 years contributing its genetic flow in natural mating to the cattle ranch [32].

At present, in the majority of Lidia farms, the reproductive handling is very traditional with natural mating of one sire and 30–40 cows during several months. The outstanding difference with the past management is that now the fertility is greater due to a better cow's body condition that allows them to perform a successful gestation and lactation every year [33] (**Figures 3** and **4**).

In Europe, the duration of the mating period in Lidia cattle is similar to that of other extensive bovine breeds, being able to reach up to 8 months (autumn–spring) in livestock farms with longer periods, but its duration is often shorter, from the end of winter to the beginning of summer (March–July), since at this time, the best results are obtained in heat of the cows and fertility, due to both photoperiod and feeding reasons. In countries as Colombia without reproductive stations, the cycle is continuous.

There are relevant anatomical differences in the reproductive system of the female of the Lidia cattle: the cervix is longer in length than other bovine breeds; they present a uterine body very short, and it seems as nonexistent during transrectal palpation [34]. It is similar to the bipartite uterus in rodents, and the ovary has a very small size compared to other breeds of similar size presenting at the oviduct level the largest infundibulum that surrounds much of the ovary [35].

At the same time, there are hormonal differences because the Lidia cow reaches puberty earlier and has a shorter gestation period than other breeds: 286 days [36]. The natural mating should last long enough to guarantee a good fertility rate, with a minimum recommended period of 3–4 months (each cow has at least three opportunities to get pregnant), but there are farmers who extend it more, and

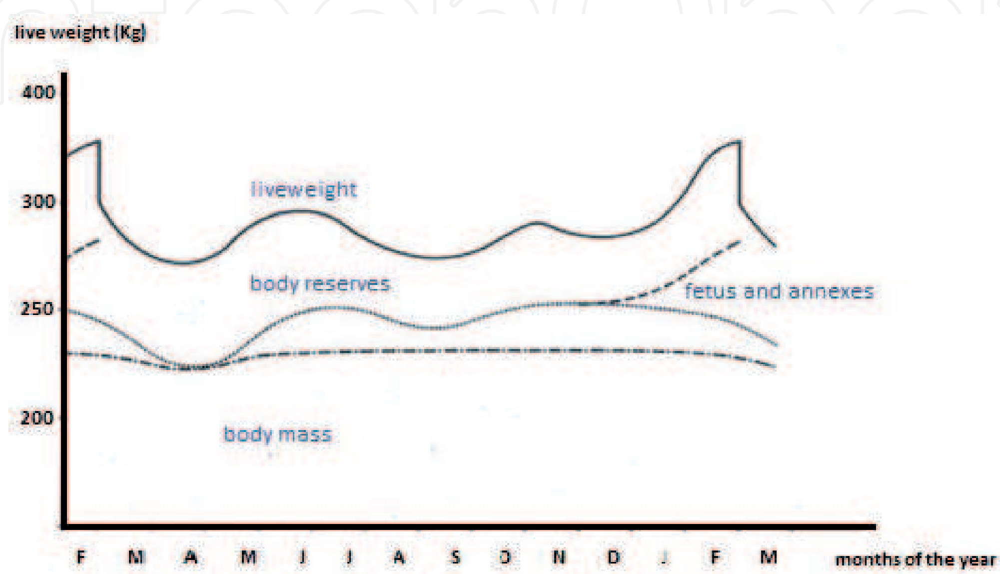

Figure 3.
Live weight variation of a Lidia cow [23].

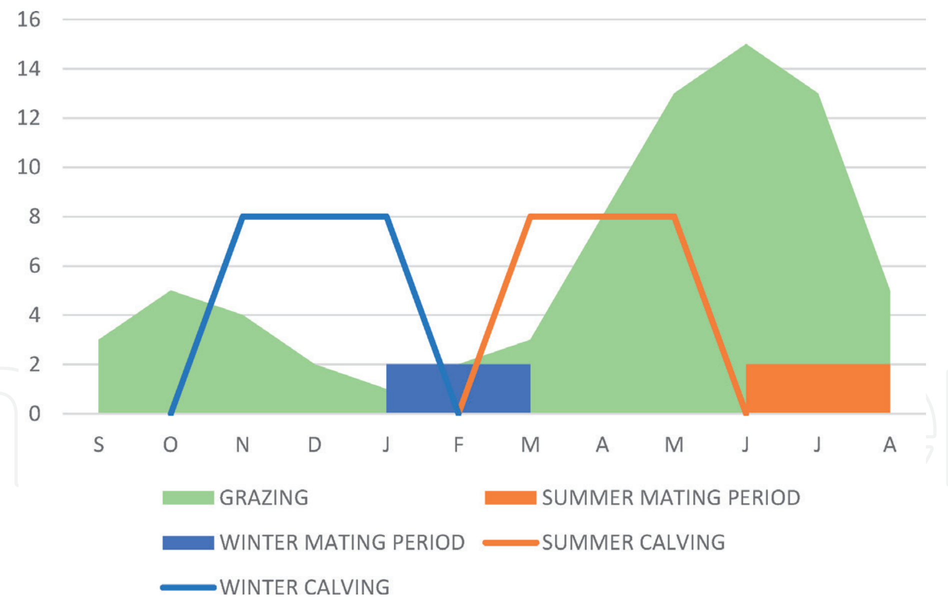

Figure 4.
Calving and natural mating management based on grazing availability in seasonal countries.

there are even systems with continuous natural mating, more common in tropical countries like Colombia. Short mating periods have the advantage of being able to concentrate the calving with better control of herd management and feeding. It is done more in larger herds, in large areas, where lactation is adapted to times of pasture abundance.

The utilization of techniques for semen collection and conservation for artificial insemination (AI) began to be used three decades ago in Lidia bulls. Later, embryo-transfer from high genetic merit Lidia cows to dairy cattle and cloning of one sire to preserve the excellent genetic quality was achieved. These reproductive methods, used to improve the productive characteristic of dairy and beef cattle, could be useful future tools to increase the genetic progress in Lidia cattle behavior selection [37].

There are immense advantages in using cryopreservation, due to semen dilution and conservation during medium and large periods, increasing the possibilities to use it for decades through AI when the behavioral results of their offspring are well known. There is also the possibility to extract *post-mortem* semen from the epididymis after the fight in the bulls of extraordinary behavior [38]. In this way, each farmer begins to have his own semen bank of his own sires and bulls. In turn, this would allow the exchange of semen between breeders, to refresh the blood of their livestock, being easy to transport to farms located in the countries of America. Among the advantages of this technique are avoid risks of contagions of potential pathologies, allowing the reproduction of animals of different sizes because natural mating is not necessary, and also is not necessary to move the male, allows the collection of semen in extreme situations, and, above all, enables the possibility to use some improving individuals of a contrasted character in a large number of females [39].

The biggest problems are due to the handling difficulties of these animals due to the untidy nature of this breed. Insemination implies added high-risk management both for animals and for people that seriously conditions, from a technical and economic point of view, its generalization in the Lidia cattle [37]. The introduction of other reproductive techniques such as early pregnancy diagnosis allows to discover and treat uterine pathologies, helping to detect nonpregnant cows that could be resynchronized or intended for natural mating and reducing calving pregnancy intervals. Reproduction control does not necessarily imply the hormonal treatment of all animals nor their subsequent insemination because it is possible to use mixed models in which the natural mating and AI are used in a complementary way [40].

Once the AI technique will be established, the next step will be to adapt an embryo transfer program to this type of cattle. Currently, it is used to preserve the valuable genetic material of small farms and to increase the reproductive efficiency of some females. In recent years, this technique has contributed to the formation of germplasm banks as genetic reserve in cases of farms with severe health problems or *encastes*[1] in danger of extinction [35].

At the same time, the use sexed semen to obtain a greater number of males than females could create an opportunity, considering the superior economic value of those. However, its use could jeopardize the process of selection and breeding of the farms due to the fact that reducing the numbers of females could be a risk if the proper and strict selection pressure is not applied.

Regarding cloning, there are many questions about its efficacy in general and in Lidia cattle in particular. It is not known, for example, if a cloned animal can develop and interact normally with its peers in a highly hierarchical and of great rivalry environment. A cloned individual may have a poor development of the immune or cardiovascular system, and it is not known whether the libido and fertility of a future cloned breeder will be normal. At the moment, it is known that it ages quicker and has a shorter productive lifespan [41]. A cloned bull must also be tested, and in the event that his quality would be acceptable, it will be also necessary to test its offspring to see if it is able to convey his characters.

The cloning of a sire, with the aim of collect semen, may be important in the case of some farms with few breeding males or if it is an individual of outstanding genetic merit and advanced age [42]. In any case, a clone might not have the same ethological characteristics as the animal from which it proceeds, since the behavior is the consequence of its genetic background, the environment in which it develops [33] its ontogenesis or sequential development.

4. Selection

Traditionally, three types of selection are made: genealogical, morphological, and functional [32]. In relation to the first, the farmer systematically records information, in his own books, the lines, or families that form the basis of the genetic heritage of his livestock, as well as the results of the offspring of each generation.

This information is used to choose future breeding animals. In addition, each farm defines its morphological preferences, depending on the type it belongs to or the priorities of the owner. The selection criteria are usually higher for males than those used for females. They focus, fundamentally, on aspects related to external appearance, neck musculature conformation, bone structure and development, and so on [43]. And finally, the functional selection consists in measuring the brave character of each animal, although each farmer understands the meaning of this term in a very subjective way. A series of tests are carried out on both females and males to assess their bravery [32].

In the case of females, animals of 1, 2, or 3 years are evaluated. The test is practiced in the *tienta*,[2] under the direction of the farmer and with the participation of professional bullfighters, trying to discover the functional performance of each animal. The behavior of each individual in each phase of the test is assessed using

[1] *encastes* = specific genetic lines in Lidia cattle breed.

[2] *tienta* = selection test applied mainly to female Lidia animals where a bullfighting show is played on livestock farm.

the horse and with the muleta. There are different parameters (prompt response, attack, fixity, mobility, nobility, fierceness, aggressiveness, repetition, and so on) that are evaluated by the farmer, to achieve a final note for each animal and, subsequently, keep the best females as breeders [44].

In the test of males, animals of 2–4 years of age are chosen, initially selecting the specimens that have obtained the best results in the genealogical and morphological tests. They are tested in a small bullring, and if the animal does not respond properly, the test is interrupted, and the bull is withdrawn and will be destined for normal fighting. Those animals initially selected, after testing the behavior of their offspring, will become part of the livestock as a sire or will be discarded, losing their value for a standard fight since they have developed sense during the test fight [32].

There is another circumstantial and sporadic form of sire selection, performed by fans and not by the farmer, which is the case of *indulto*.[3] It occurs in the context of a bullfight where many influential factors could alter the true criteria by which a bull must be selected. Therefore, it is the breeder who will decide, later, if the animal should be used for reproductive purpose or not.

Currently, another type of selection, genetics, has been introduced by livestock associations, which has become increasingly important [9]. It consists of identifying the individuals carrying the most beneficial genes for the interest characters and using them as breeding animals to transmit them to their descendants. The way to evaluate whether or not the phenotype of an animal is a good reflection of the genes of which it is a carrier (genetic value or merit) is based on calculating the heritability of that character [45].

The capacity to transfer behavioral characters is very slow because it is limited by the production of a calf per year, at the most, as well as the complexity to accurately and quickly assess the ethological response of its products in the show [46].

According to Cañón et al. [2], many of the behavioral characters manifested by the Lidia bull, such as mobility, repetition, nobility, rhythm, and fierceness, despite its complexity and subjective assessments, if scored with enough rigor, can manifest high heritability (>0.35) that makes them susceptible to be selected in one way or another, at the choice of the farm's owner.

A very precise selection of the best individuals entails the maintenance of a population with high consanguinity; therefore, controlling it is an always necessary activity in a Lidia cattle ranch, preserving the necessary genetic variability within it. In general, in Lidia farms, the level of consanguinity does not seem to be very high: 0.12 and 0.13 [47]. Even so, it is possible to find bulls with a consanguinity coefficient of 0.25 [48]. However, regulated mating strategies should be followed, to avoid mating animals with common ancestors, establishing a short- or medium-term conservation program. However, we must be aware of the difficulties involved in the conservation of some minority genetic lines, cattle ranches, or "*encastes*" [48], because the smaller a population is and the greater the imbalance between the sexes the more difficult it is to preserve their genetic characteristics, complicating the task of avoiding mating between related animals.

Finally, the incorporation of the computer methods to control the productive data of the animals allows organization and best valuation of each reproductive potential. With the information reduced to informative schemes, the results can be checked immediately, which make it possible to know, through the corresponding analysis of the offspring, the racing power of the father or mother [45, 49–51].

[3] *indulto* = situation when a bull that has been excellent in the fight and is not sacrificed to be incorporated into his home field as a stud.

5. Main pathologies

The most frequent diseases of Lidia cattle, which also affect extensive cattle, are parasitic processes (coccidiosis, ostertagiosis, dictyocaulosis, and sarcosporidiosis), infectious processes (clostridiosis, anthrax, paratuberculosis, tuberculosis, actinomycosis, actinobacillosis, and pyobacillosis), poisonings (aflatoxicosis, ochratoxicosis, aluminum phosphide, and lead poisoning), and deficiency processes as poliencefalomalacia [52].

In addition, the extensive nature of this animal production system predisposes him to suffer from eye problems such as infectious keratoconjunctivitis and horn wounds due to fights between animals [53]. The latter represents a very important chapter in the economies of Lidia farming assuming losses of traumatic etiology ranging from 3 to 15% of male adult individual. Most of them require surgical treatment; some of the interventions are simple, and others are more complicated, but all have in common the septic character of the traumatic focus [54].

The gorings have an etiology closely related to the age of the bulls, strength, and *encaste*, with an increase in frequency of incidence in 4-year-old bulls with a weight of 500 kg, and the wounds occur with a greater probability in the head and extremity regions. They are caused by external violence in which the surface of the traumatic agent is wide. We can find open or closed wounds. The closed wounds, even when not seen to affect external skin tissues, can cause internal muscular or vascular lesions. Hematomas or serous effusions (blood and lymphatic exudates) of difficult reabsorption due to their large size appear, and they require intervention. They evolve to contamination and abscess formation [55].

The treatment of all types of wounds should be focused on controlling, primarily, the bleeding, either by suturing damaged vessels or by hemostatic parenteral treatments, then preventing or controlling the infection, disinfecting and cleaning the affected area, and finally achieving the rapid healing, usually by second attempt, and is always suggested to leave a drain at the trauma point even if it is small [56].

Another pathology that has been observed with a high incidence in the Lidia breed is osteochondrosis [57]. It is a degenerative process of the joint surfaces, widely described in horses and in bait cattle of other breeds, with few studies in fighting bulls to know if it could influence the mobility of the animal during the show [27].

5.1 Ruminal acidosis (RA)

RA is a metabolic disease that settles in the rumen and is produced by the ruminal fermentation of large amounts of nonfibrous carbohydrates, such as starch and sugars, which lead to the production of high amounts of volatile fatty acids (VFAs) and lactate, which accumulate in the rumen and cause an abnormal reduction in rumen pH [58]. Ruminal epithelial cells, not protected by mucus, are vulnerable to chemical acid damage [59], and this decrease in ruminal pH together with high concentrations of VFAs causes ruminitis, erosions, and ulcerations of the ruminal epithelium. In turn, abnormal thickening of the stratum corneum of the mucosa occurs due to accumulation of corneal cells with perturbations in their keratinization resulting in hyper and parakeratosis, observing partially pigmented ruminal mucous membranes [60, 61].

Among the works carried out on the feeding management of the Lidia bull, the one carried out by Bartolomé [26] stands out because he observes 66.2% of the animals studied with ruminal pH values compatible with RA, of which 41.5% chronically (pH = 6.2–5.6) according to the classification of González et al. [62]. In addition, 70.7% of animals presented parakeratosis in the mucosa, and in 26.9%

of bulls sampled, liver lesions were detected. In the same line, Lomillos et al. [27] reported a 43% reduction in the length of the ruminal papilla of bulls subjected to the finishing bait, added to an increase in the thickness of their mucosa, which approximately doubled the value obtained in the group of animals considered control, and maintained in pure extensive regime (**Figures 5** and **6**).

In this context, the decrease in rumen pH predisposes the epithelium to become fragile and loses its ability to act as a barrier between the ruminal environment and the blood, which predisposes the appearance of continuity solutions, which allow the passage of microorganisms toward the bloodstream and the consequent risk of suffering sepsis for the animal [60]. Among others, *Fusobacterium necrophorum* and *Corynebacterium pyogenes*, are bacteria often carried to the liver through the portal vein, and there they begin infection and abscess formation, which compromise their metabolic capacity [5]. From the liver, they can go to the peritoneum, generating peritonitis, and sometimes they can go to the lung, heart valves, kidneys, joints, and so on [63]. In this sense, García et al. [12] recorded abscesses at the liver level in 4% of the studied bulls and hepatic-diaphragmatic adhesions in 21% of cases that extended to the pulmonary pleura, confirming, after culture, *Fusobacterium necrophorum* as the main causative agent of lesions.

At the same time, the intense finishing feeding management based on the use of high amounts of carbohydrates is a predisposing cause of hoof lesions such as the lameness by diffuse aseptic pododermatitis observed in the animals as an excessive growth of the hoof [60] widely described in Lidia cattle [25, 29] and detected with a prevalence of 28% in the fought animals [12].

According to Nocek [64], the relationship between RA and laminitis seems to be associated with hemodynamic alterations of peripheral microcirculation. During acidosis, as a consequence of the decrease in ruminal pH, a process of bacteriolysis takes place in the rumen, releasing vasoactive substances (histamine and endotoxins), which are absorbed through the damaged rumen wall and cause vasoconstriction and dilation, which destroy microcirculation at the level of synovial joints and chorionic tissue of the hoof [65, 66]. The combination of high concentrations of histamine in areas of terminal circulation [67], the increase in digital blood flow and high blood osmolarity induce an increase in blood pressure inside the animal's hoof, producing a serum exudate, which results in edema, internal hemorrhages from thrombosis, and finally, the expansion of the chorion, causes intense pain [60, 64]. The disease presents with signs of lameness, excessive growth of the hooves, and the appearance of dark lines or bands on the surface of the hooves, a consequence of the ischemia generated by vascular damage and

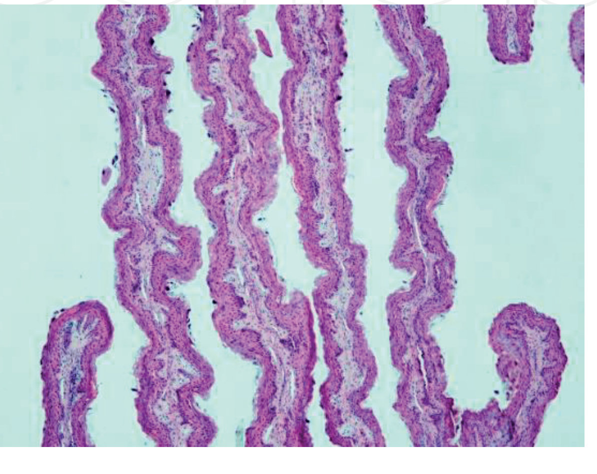

Figure 5.
Normal papilla of extensive animal.

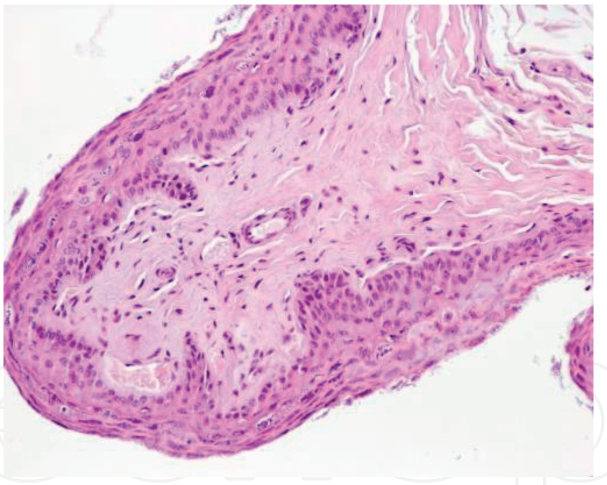

Figure 6.
Thickened and shortened papilla of finished bulls [27].

edema [68]. At present, lameness is treated with anti-inflammatories, and the hoof overgrowth is usually remedied in livestock by a functional cut of the hoof, using the cattle crush facilities to immobilize the animal.

It seems clear that the RA generated after the intensive bait and the pathological processes to which it predisposes or directly causes, affects the performance of the bull in the arena in the form of physical decline of the animal that hinders its ethological and physical performance [12, 20, 26, 69]. Therefore, it is of great importance to explore possible solutions or prevention strategies by designing a new food management.

To control the process, in principle, it would be enough to reduce the amount of nonfibrous carbohydrates provided with the diet, but this measure would lead to a decrease in the rations' energy level, with the consequent delay in the fattening of the bull and the consequent economic losses.

In the case of the final bull bait, improved rationing and feeding management could have a considerable impact on rumen pH stability. Adapting the ruminal environment by slowly and gradually changing from one forage feed ration to another concentrate would stimulate the development of the rumen papillae and the growth of the lactic acid transforming flora [5], in such a way so that a greater amount is metabolized and the mucosa of the rumen can absorb a greater amount of generated VFAs. This adaptation of the mucosa to concentrated rations takes approximately 4–6 weeks [64] and changes in microflora about 3 weeks [70].

The adoption of the mixed total ration type feeding system, better known as "unifeed" carriage (**Figure 7**), widely used in dairy cattle, ensures a balanced consumption of concentrate and forage, which is a very important advantage. In this way, it is possible to increase the energy density of the rations by reducing the risk of digestive problems [71]. In fact, in recent years, this type of food management has begun to be incorporated into the Lidia farms, mainly in farms located in the south of the peninsula, later extending through Madrid and Salamanca [72].

In this sense, the contribution of compensated and high fiber rations through the use of "unifeed" mixer cart during the bull bait does not generate a pH decrease below the physiological limits, as shown in Graph 1 that describes the pH ruminal of bulls fed following this pattern of food management for a month [31]. However, it is not clear that this handling is the solution to the RA of the bull since the use of these mixing machines during the entire bait period, which usually lasts between 3 and 9 months, can generate lesions in the morphology of the papilla ruminal (decrease in length and thickening of the mucosa) similar to those found in animals

Figure 7.
Small format "unifeed" mixer truck, adapted to Lidia cattle (BIGA).

fed through traditional feeding management. In addition, the feeding time generates a negative effect on the severity of the lesions, with the animals fed for more than 6 months being the ones with the greatest lesions at the level of the rumen mucosa [27].

Another strategy to prevent RA is the use of additives both chemical and microbial. Among the first are buffer substances such as bicarbonate, alkalizing agents such as magnesium oxide, or adjuvants such as bentonite, which can help fight RA because it absorbs part of the volatile fatty acids at the ruminal level [5, 65, 73, 74]. The most commonly used microbial additives to combat RA are yeast extracts and live yeasts. These microorganisms help maintain ruminal pH by stimulating the growth of cellulolytic bacteria and lactic acid users, preventing their accumulation in the rumen [75].

5.2 Falling syndrome

Muscle weakness syndrome, which involves motor incoordination and transient loss of standing and balance, all encompassed under the common term of "falling syndrome," has been worrying different authors for almost a century [76]. The frequency with which this problem occurs in the arena had not become worrisome until the beginning of the last century, from the being of 1930 when the manifestation of the problem became general and the falls were more frequent and alarming [77], reaching incidence percentages in the most critical decades close to 99% [78] or 98% [26] of the sampled animals. It affects both males and females and specimens of all ages: bulls, calves, and cows [79, 80]. It is observed in individuals of different livestock farms, regardless of their weight, the category of the arena where they fought, the distance from its farm of origin [77], and, additionally, within the same livestock, the incidence of this problem can be very diverse.

Despite recent research work done in this regard, the falling syndrome of the brave bull is an issue in which consensus is not yet perceived. The theories that have come to light in order to explain the etiology of the syndrome have been very numerous and varied, without any of them providing definitive conclusions to date. The simplest attributes the problem to physical reasons such as transport trauma and intentional fraud, while others, more complex, consider that the origin of the syndrome is genetic, due to the inheritance of a gene that determines the fall [81]. However, given the appearance of the problem in cattle ranches whose original genetic distance is very wide, it is logical to assume that the appearance of this syndrome must be influenced by the action of the environment, within which food management, in addition to other factors, such as the health status of the livestock itself would play a very important role.

Nowadays, in view of the different studies carried out, it is possible to think that the falling syndrome is a multicausal problem, where we can observe some predisposing causes, such as the genetic endowment, the characteristics of the transport, the physical demands of the fight, the effect of the *puya* and the *banderillas*, the lack of functional gymnastics, nutritional deficiencies, and other more determinants, such as the possible pathological, circulatory, nervous, metabolic, endocrine, genetic, or ethological causes [76].

On the other hand, the bull is by nature a sedentary animal. In the last year of life, he is transferred to small enclosures where his chances of exercising naturally are limited and the energetic components in his diet are increased. Although cattle are not considered an athletic species, the bull is subjected to tremendous exercise in the arena, lasting approximately 20 min, maintaining a physical and metabolic effort of great intensity to which it is not accustomed [82]. These circumstances mean a lack of physical condition for the show.

This muscle weakness, manifested in the falling syndrome, is projected in various acute muscle injuries associated with intense physical exercise and in chronic muscle injuries that may result from nutrient deficiencies of selenium and vitamin E [83]. On the other hand, Aceña et al. [84] demostrated the existence of a reduction in glycogen stored and very high concentrations of lactic acid in the muscles at the end of the fight, results that indicate the existence of muscle fatigue due to physical exercise in an anaerobic situationss. Similarly, a high correlation has been observed between the main parameters indicative of metabolic acidosis (HCO_3^-, lactate, and low blood pH) and respiratory acidosis (PCO_2) with the falling syndrome [69].

Therefore, it is essential to subject the animals to a physical preparation and adaptation to the fight. In fact, in recent years, the number of farmers who seek to achieve adequate physical condition in their animals has increased, through an empirical training program along a running track or by moving them in the same enclosure where they normally live.

There are few studies on the effect of training on the physiology of the bull [85–87]; however, we can state that training potentially increases athletic performance, as can be deduced from muscular and blood metabolic adaptations [88, 89]. It has been observed that training favors the β-oxidative metabolic pathway of fatty acids (oxidative metabolism) prevailing over the glycolytic pathway, requiring a protocol of at least 6 months to increase its antioxidant capacity [89, 90].

In addition, this training would increase the muscle mass of the animal favoring physical performance [91]. To train, and for the result to be effective, great care of the diet should be taken into account since, in the finishing phase of the bulls, it is intended that the animal's body weight increases and that the training will serve to increase muscles and adapt the cardiovascular system to an aerobic exercise. With this training management, it is being pursued that the bull endures the fight better, increasing its mobility while achieving greater lung capacity and, therefore, a greater chance of recovery, after efforts made in the first moments of fight.

With training, physical capacity is enhanced, stimulating the body's level of work above normal. These animals have a great capacity for adaptation and although at the beginning of the training they show signs of fatigue and body loss, this is followed by a phase of recovery/adaptation and maintenance of body weight.

A basic training program would consist of three sessions per week, within a total period of 5–6 months, depending on the date scheduled for the fight. A group of animals, with a variable number of bulls, around 12, are forced to move for approximately 3 km, accompanied by horsemen.

It usually begins with a weekly session, increasing the pace until reaching 3 sessions/week in the second month. The intensity is progressive, each session begins with the first minute to the step, to warm the animals, increasing the pace until they are trotted or lightly galloped, to return to the initial point in a progressive cooling. The orography of the land is usually flat, but there are farmers who prefer to exercise the cattle on sloping terrain to increase the intensity of the session. This training is interrupted approximately 15 days before the fight [92].

Each breeder has been carrying out a particular training protocol, adapted to their availability of time and cowboys, the number of animals they intend to prepare, and the date of their fight. Generally, a more intense preparation is usually carried out with bulls whose destiny is first or second category arena. In turn, the orographic characteristics of the farm, its distribution of fenced areas, and its extension will have an important influence on the programmed exercise.

5.3 Health management

Considering the high economic value of the Lidia breed animals, the number of farmers who establish a health management program in their livestock as a control system against infectious or parasitic diseases, and to increase fertility and pregnancy rates as well as to decrease mortality rates in new-born calves, is rising in recent years.

Problems related to infectious and contagious diseases represent the main source of economic losses. The pathogens that have tropism for the reproductive, respiratory, or digestive system stand out. Therefore, reproductive and respiratory alterations and neonatal diarrhea are the main problems we find in these cattle [93].

Currently, there are several emerging diseases that could affect these animals during the last decade such as blue tongue, foot and mouth disease, or bovine spongiform encephalopathy, which have joined those that already have an eradication program in our country (brucellosis and tuberculosis), which require periodic official livestock checking on farms (Order DES/6/2011). On many occasions, the health problem itself is linked to a cumbersome legislation that hinders the transit of animals through the various communities of the national territory and between intracommunity countries such as Spain, France, and Portugal (Royal Decree 186/2011).

The official campaigns of eradication of brucellosis and tuberculosis are based on hard controls of the herds and on the application of a legal regulation on these aspects that makes, in certain cases, the movement of animals from the infected cattle ranches, including sales for bullfighting, impossible [94]. It is essential to consider the peculiar factors of this cattle production system. One of them is the level of consanguinity within some farms with a very small number of individuals, which works against disease resistance. It is also necessary to consider the complexity of handling these animals, which coexist in extensive systems with species of different sanitary categories (hunting and/or wild) that could be reservoir for numerous diseases.

In addition, cross-reactions with paratuberculosis (a widespread disease in the Spanish countryside) compromise the reliability of diagnostic analytical tests, posing serious problems when addressing eradication plans [95]. The fight against diseases, both endemic (tuberculosis and brucellosis) and emerging (bluetongue), to achieve eradication and control, will be one of the workhorses for the Lidia sector. This should not entail, in any case, any risk to the maintenance of the diversity of *encastes* and genetic lines that characterize this breed. Important and unique farms for their genealogy are being decimated by this cause, to the point of endangering the survival of certain *encastes*.

6. Sheathed of horns

One of the most valued and delicate body parts of the bull is its horns. They suffer a risk of deterioration, mainly in the last year of life, as a result of potential fights, friction, contacts, or blows with the ground, with trees, fencing, feeders, or the walls of the handling facilities [96]. Therefore, to protect the horns during the last year of animal live, a fiberglass bandage is placed on the horns, easy to handle, porous and that hardens quickly by polymerization with water, providing good consistency (**Figure 8**). The technique consists of immobilizing the animal in the restraining facilities and wrapping the horn with this bandage to protect it from any aggression or friction. The distal part of the horn is reinforced in many cases with metal tubes or similar hard materials, in order to reduce the wear of the apical zone [97, 98].

The horn is increased in thickness by the sheath, and the end of the horn is blunt, which decreases the effect of the lesions of horns between animals by 90% and, in addition, improves their handling for vaccinations, deworming, and other treatments, due to the risks of deterioration of the defenses when the animals pass through the handling facilities minimized [99]. In spite of the obvious advantages of the sheathing mentioned above, and the answer to many questions about the influence of this management practice on the structure and corneal anatomy and the ethological performance of the animal in the arena provided by Alonso et al. [100], there is still some controversy about its usefulness.

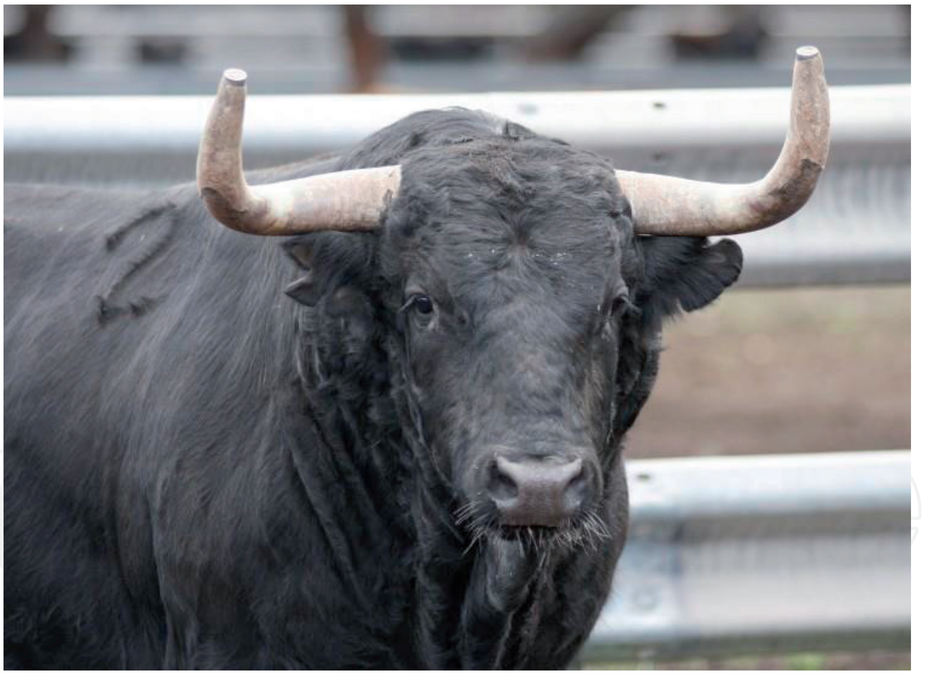

Figure 8.
Lidia bull with protected horns.

7. Conclusions

Lidia cattle production presents unique characteristic that requires farmer and veterinary knowledge about the particularities of these animals and its management. The Lidia production sector, from its origins, has been adapting to the new times making use of the most current technological advances. In this way, the feeding system, selection criteria, and reproductive techniques have been modified, driving the need for a modernization of the medical and management practices.

However, there are difficulties associated with the breeding, either because of the temperament of animals that increase the difficulty in handling, as well as to the predisposition to present diseases that greatly affect the animal, such as the ruminal acidosis, the falling syndrome, and some health problems that it shares with other extensive bovine cattle.

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